ARIZ 806e
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(6 Pages)

MAXIMUM THEORETICAL SPECIFIC GRAVITY OF LABORATORY PREPARED BITUMINOUS MIXTURES (RICE TEST)

(A Modification of AASHTO T 209)

SCOPE

1. This method of test is intended for determining the maximum specific gravity of uncompacted bituminous mixtures which have been prepared in the laboratory.

APPARATUS

2. The apparatus shall consist of the following:

(a) Balance - A balance accurate to 0.1 gram at the maximum weight to be determined.

(b) Container - A heavy walled Erlenmeyer flask having a capacity of at least 1500 ml. strong enough to withstand a partial vacuum; the cover shall consist of a rubber stopper with a tight hose connection. A small piece of No. 200 wire mesh covering the hose opening shall be used to minimize the possibility of loss of fine material.

NOTE: If a procedure which subjects multiple flasks to a vacuum simultaneously is used, the vacuum gauge shall be placed beyond the last bottle to insure that all the bottles are being subjected to the same amount of vacuum.

(c) Glass cover plate large enough to cover mouth of the flask.

(d) Vacuum pump for evacuating air from the container.

(e) Ovens - One oven capable of maintaining a temperature of 255° ± 5°F and one capable of maintaining approximately 300°F.

(f) Distilled water - All water used in this procedure shall be distilled water.

(g) Mixer - A mechanical commercial dough mixer with a minimum 10 quart capacity and equipped with a wire whip.

CALIBRATION OF FLASK

3. Calibrate the flask by accurately determining the weight of water at 77° ± 1°F required to fill it completely. Use of a glass cover plate is required to ensure accurate filling. Record the weight of the flask + water to the nearest 0.1 gram as "B".

PREPARATION OF SAMPLES

4. (a) One aggregate sample of 3000 grams, proportioned in that grading determined by design, is required for each test. The 3000 gram aggregate sample will provide 3 test samples when mixed and split as described below.

(b) To minimize stripping of the asphalt from the aggregate, pre-weigh a 300 to 500 gram sample of asphalt and add to this 1.0% of a suitable anti-stripping agent by weight of asphalt. This mixture will be designated as "binder" in this test.

NOTE: Pave Bond Special is the preferred anti-stripping agent.

(c) The percent binder used shall normally be 6.0%.

NOTE: A binder content of 6.0% will normally give satisfactory results, although aggregate characteristics and gradation may require adjustment in percentage of binder to be used.

(d) The temperature of the asphalt and aggregate at the time mixing begins shall be in accordance with the following:

Asphalt Grade	Temperature Range
AC 20	300° ± 10°F
AC 30, AC 40	305° ± 10°F

(e) The aggregate shall be dried to a constant weight, at the temperature required as shown in paragraph 4 (d). Bring samples to desired weight by adding a small amount of proportioned Pass No. 8 makeup material.

(f) The aggregate and asphalt shall be mixed mechanically for 90 to 120 seconds and then hand mixed as necessary to ensure thorough coating.

NOTE: Before each batch is mixed, the mixing bowl and whip shall be at approximately the temperature specified in 4 (d).

(g) The mixed sample shall be placed on a tarp or sheet of heavy paper and in a rolling motion thoroughly mixed. The material shall be spread into a circular mass 1 1/2 to 2 inches thick. The circular mass shall be cut into 6 equal segments taking opposite segments for each individual sample.

(h) Place samples in an oven maintained at 255° ± 5°F and cure for 2 hours ± 5 minutes. After curing, spread each sample on a sheet of heavy paper or in a large flat bottom pan. Before the samples are completely cooled separate the particles of the mixture, taking care not to fracture the mineral particles, so that the particles of the fine aggregate portion are not larger than 1/4 inch. Allow the samples to cool to room temperature.

PROCEDURE

5. For each sample the procedure below shall be followed:

(a) Place the sample in the flask and determine weight of sample to the nearest 0.1 gram. This is designated as the "weight of sample in air", or "Wmm".

NOTE: Care should be taken in mixing and transferring of the samples to the flask so that there is no more than an 18 gram difference between the total weight of aggregate and binder before mixing and the total "weight of the samples in air".

(b) Add sufficient water, which has been treated with a wetting agent, to cover the sample.

NOTE: A suitable wetting agent such as Aerosol OT in a concentration of 0.01%, or 1 ml. of 10% solution per 1000 ml. of water, shall be used to facilitate the release of entrapped air.

(c) Remove entrapped air by subjecting the contents of the flask to a partial vacuum, with a minimum of 20 inches mercury for 15 ± 2 minutes. Agitate the contents three or four times within this period, to dislodge trapped air bubbles.

CAUTION: Do not agitate the sample too frequently or vigorously; this can cause stripping of the film from some particles, resulting in erroneous specific gravities.

(d) After the evacuation period, fill the flask completely with water, slide a preweighed glass cover plate over the mouth of the flask, and weigh immediately to the nearest 0.1 gram. The temperature of the flask, water, and sample shall be between 72°F and 80°F. Record as the weight of the "flask + water + sample", or "C".

(e) The entire contents of the flask shall be poured into a nest of sieves consisting of a No. 40 and a No. 200 screen.

NOTE: If stripping has occurred, as evidenced by discoloration of water in the flask, significant loss of minus No. 200 material may be expected. Provisions for the recovery and addition of this material to the Plus No. 200 material shall be made.

(f) Allow mix to drain through the sieves until excessive moisture is removed from mix. Spread the material retained on the No. 40 and No. 200 sieves in a pan and place before an electric fan to remove surface moisture. The air through the fan shall be at room temperature and no heat shall be used to dry the mix.

(g) After evaporation of excess moisture is observed, weigh mix at 15 minute intervals and when the weight loss is less than 0.5 gram for this interval the mix is considered to be surface dry. Record the surface dry weight as "Wsd". Intermittent stirring of the sample is required during the drying period. Conglomerations of mix shall be broken by hand. Care must be taken to prevent loss of particles of mixture.

NOTE: If the "Wsd" weight for any of the three samples is less than its corresponding "Wmm" weight the samples shall be discarded and a set of three new samples shall be prepared and tested.

CALCULATIONS

6. (a) The Volume of Voidless Mix, "Vvm", in ml. is determined for each sample by the following:

$$Vvm = Wsd + B - C$$

Where: Wsd = Surface Dry Weight
B = Weight of Flask + Water
C = Weight of Flask + Water + Sample

(b) The Maximum Specific Gravity, "Gmm", is determined for each sample by the following:

$$Gmm = \frac{Wmm}{Vvm}$$

(c) Compare the three individual values for maximum specific gravity. If the range of the three is within 0.014, all are used to determine the average maximum specific gravity as

shown in paragraph (d) below. If the range is greater than 0.014, the average of two may be used if they are within a range of 0.007. If values are not achieved within the above criteria, the samples shall be discarded and a set of three new samples shall be prepared and tested.

NOTE: For recycle mixes the above criteria shall be replaced with 0.024 for the range of three and 0.012 for two.

(d) The average maximum specific gravity of the bituminous mix is determined for the samples with acceptable maximum specific gravity values, and recorded to the nearest 0.001 unit.

(e) To determine the maximum density, the average maximum specific gravity is multiplied by 62.3 lbs/cu ft.

EXAMPLE

7. An example of the calculations is shown in Figure 1.

NOTE: The form shown in Figure 1 contains equations which shall be used to determine the combined bulk oven dry specific gravity of aggregate, the effective specific gravity of aggregate, and the asphalt absorption. These values are utilized in determining the voids relationships for the bituminous mixture. The areas provided on the form in Figure 1 may be conveniently used to perform these calculations.

ARIZONA 806

LAB. NO.: 88-999B PROJECT NO.: F-099-9(11) DATE: 1-12-88
PROJECT NAME: CHRISTMAS CANYON - CLAUS T.I. MATERIAL TYPE: 3/4" A.C.
GRADE OF ASPHALT: AC 40 SPECIFIC GRAVITY OF ASPHALT: 1.023 PERCENT OF ASPHALT: 6.0
TESTED BY: JOE TESTER CHECKED BY: S.C.

FLASK NUMBER	WEIGHT OF FLASK	"Wmm" WEIGHT OF SAMPLE IN AIR	(B) FLASK + WATER	(C) FLASK + WATER + SAMPLE	"Wsd" SURFACE DRY WEIGHT	"Vvm" VOLUME OF VOIDLESS MIX (Wsd+B-C)	"Gmm" MAX. SP. GR. "Wmm" / "Vmm"	MAXIMUM DENSITY LBS. PER CU. FT. "Gmm"x 62.3
1	1185.9	1057.6	3429.9	4046.7	1058.4	441.6	2.395	
2	1280.0	1059.2	3499.2	4116.1	1060.3	443.4	2.389	
~~3~~	~~1178.1~~	~~1057.2~~	~~3436.1~~	~~4053.6~~	~~1059.1~~	~~439.6~~	~~2.405~~	
AVERAGE							2.392	149.0

MIX WT. - TOTAL SAMPLE WT. = LOSS OF GRAMS = 8.4

FLASK NUMBER:	1	2	3
WT. OF SAMPLE AND FLASK	2243.5	2339.2	2235.3
WT. OF SAMPLE, FLASK, WATER AND GLASS PLATE	4201.8	4271.2	4208.7
WT. OF GLASS PLATE	155.1	155.1	155.1

% COARSE AGG. = 41 % FINE AGG. = 59
COARSE AGG. BULK O.D. SP. GR. = 2.558 FINE AGG. BULK O.D. SP. GR. = 2.589

COMBINED AGG. BULK O.D. SP. GR. (Gsb) =

$$= \frac{100}{\frac{(41)}{(2.558)} + \frac{(59)}{(2.589)}} = 2.576$$

EFFECTIVE SPECIFIC GRAVITY OF AGGREGATE (Gse) =

$$= \frac{(100) - (\%\ \text{ASPHALT})}{\frac{(100)}{(Gmm)} - \frac{(\%\ \text{ASPHALT})}{(\text{ASPHALT SP. GR.})}} = \frac{(100) - (6.0)}{\frac{(100)}{(2.392)} - \frac{(6.0)}{(1.023)}} = 2.615$$

ASPHALT ASBORPTION (Pba) =

$$\left[\frac{(Gse) - (Gsb)}{(Gse) \times (Gsb)}\right] \times (\text{ASPHALT SP. GR.}) \times (100) =$$

$$= \left[\frac{(2.615) - (2.576)}{(2.615) \times (2.576)}\right] \times (1.023) \times (100) = 0.59$$

REMARKS: FLASK #3 ELIMINATED DUE TO BEING OUTSIDE 0.014 ALLOWABLE RANGE.

FIGURE 1